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TWO NEW ATLANTIC SPECIES OF DOG SHARKS, WITH A KEY TO THE SPECIES OF MUSTELUS

By Stewart Springer

During the winter months of 1935 to 1938, more than 50 specimens of dog sharks were taken off Englewood on the west coast of Florida and brought in to the Bass Biological Laboratory. All were mature males and were taken in relatively shallow water with gill nets and trammel nets. No substantiated records were found of dog sharks in Gulf waters north of Key West, Fla. These specimens with one other, fortunately an adult female with embryos, in the collection of the United States National Museum, represent a species here described as new and named for Prof. H. W. Norris, of Grinnell College.

In examining the collection of dog sharks in the National Museum, I studied and compared a series of specimens from the east coast of South America with a large series of *Mustelus canis* from the east coast of North America. Constant differences were noted, sufficient to warrant the separation of the South American form as a new species, which is named for Dr. Waldo L. Schmitt, curator of the division of marine invertebrates at the National Museum, collector of the type.

In gathering material for the preparation of these descriptions, I examined the types of *Mustelus lunulatus* Jordan and Gilbert, *M. fasciatus* (Garman), *M. abbotti* Evermann and Radcliffe, and *M. nigromaculatus* Evermann and Radcliffe and studied good series of the species from North America and Japan and representative series of most other species. No specimens were seen certainly referable to *Mustelus punctulatus* Risso, *M. osborni* Fowler, or *M. mento* Cope, and the European and Australian specimens available for study were few.

I am indebted to the authorities of the United States National Museum, the Museum of Zoology of the University of Michigan, the Field Museum of Natural History, and the Stanford University Museum for loans of material and to the Museum of Comparative Zoology at Harvard University for permission to examine specimens in its collections, as well as to Bass Biological Laboratory, for facilities for carrying out the present study. I am very grateful to Earl D. Reid, A. C. Weed, Prof. G. S. Myers, Dr. A. W. Herre, Frank Firth, and Prof. H. B. Bigelow for assistance in making material available for examination, and especially I wish to thank Drs. Leonard P. Schultz and Carl L. Hubbs for their generous help, without which I would have been unable to prepare this paper.

Genus MUSTELUS Linck

MUSTELUS NORRISI, new species

Holotype.—An adult male, 723 mm in total length, U.S.N.M. no. 106639, collected off Englewood, Fla., in about 3 fathoms, March 5, 1938, by Stewart Springer.

Allotype.—An adult female, 825 mm in total length, U.S.N.M. no. 57369, collected in Sawyers Key Channel, a few miles northwest of Key West, Fla., December 14, 1906, by the *Orion*. Six embryos, ranging in size from 182 to 194 mm, were taken from the uterus of one side, and approximately the same number were present in the other side. While the embryos did not have a clearly defined pseudoplacenta, they appeared to be nearly ready for birth, and these organs may have been partly absorbed by the embryos. There were no indications of partitions separating the embryos in the uterus.

Paratypes.—U.S.N.M. no. 104333; Univ. Mich. Mus. Zool. no. 117094 (2 specimens); Bass Biol. Lab. nos. 317, 318, 320, and 321.

Description.—A small species (males mature at 600 mm or less in contrast to those of *M. canis*, which become mature at 750 mm or more). Form slender, tail long, back little elevated. Head relatively narrow, flattened above; snout rounded, of moderate length. A middorsal ridge in the skin extending from before the first dorsal between the fins to the caudal. Fins relatively small; pectorals narrow; lower lobe of the caudal well developed and acute in full-grown specimens; origin of the first dorsal behind the inner angle of the pectoral. Eyes large, with diamond-shaped pupils; distance between nostrils less than horizontal diameter of the orbit. Mouth small, greatly arched, not broadly rounded anteriorly, the lines of occlusion of the jaws forming an angle of 90° or less at the apex; outer labial fold either longer or shorter than the inner, of variable length. Teeth paved but with elevated blunt crowns, higher than in most species of *Mustelus;* with several series in function, teeth of upper and lower

jaws similar, vestigial accessory cusps present on occasional teeth but most of these single; a few teeth, tricuspid in outline, in most specimens examined. Dermal denticles of adults similar in structure over the flat surfaces of the skin of the body, typical denticles regular in outline, 4-ridged, with the two central ridges reaching or nearly reaching the posterior apex, denticles usually longer than broad (one of average size, 0.21 by 0.35 mm), 6-ridged denticles rare even along the

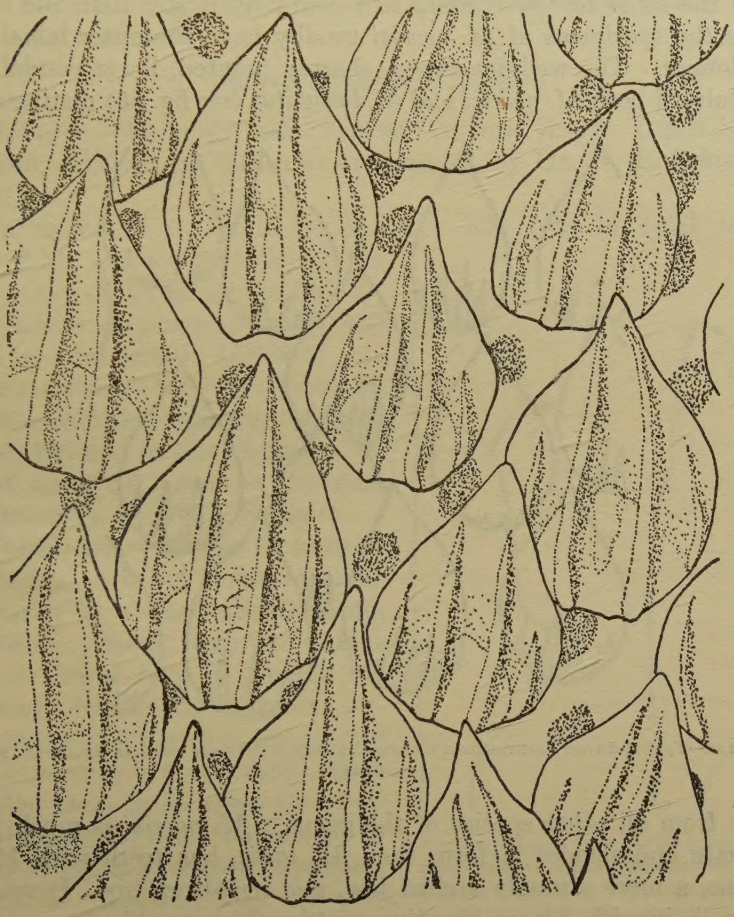

FIGURE 53.—Typical dermal denticles from the lateral surface of *Mustelus norrisi*, new species, showing long ridges, reaching or nearly reaching the apex.

middorsal line. Color uniform, without lighter or darker spots; light gray. Measurements of the types are given in table 1.

Comparisons with other species.—Because of differential growth, especially pronounced in this family as soon as maturity is reached, measurements expressed as a percentage of the total length have little value for taxonomic purposes unless several factors are taken into

consideration. Much more material than I have examined would be required to determine the extent of variation in form within species of dog sharks, but the specimens seen do not demonstrate great variation in form when individuals of the same length and sex are compared.

Mustelus norrisi is most closely allied to *M. lunulatus* Jordan and Gilbert but may be distinguished from it by the more posterior position of the first dorsal. The specimens of *M. lunulatus* seen by me have the inner or lower labial fold definitely longer than the outer, while the specimens of *M. norrisi* usually have the outer labial fold the longer. The well-developed, sharply pointed, lower caudal lobe in adults of both *M. norrisi* and *M. lunulatus* (see fig. 55) distinguishes

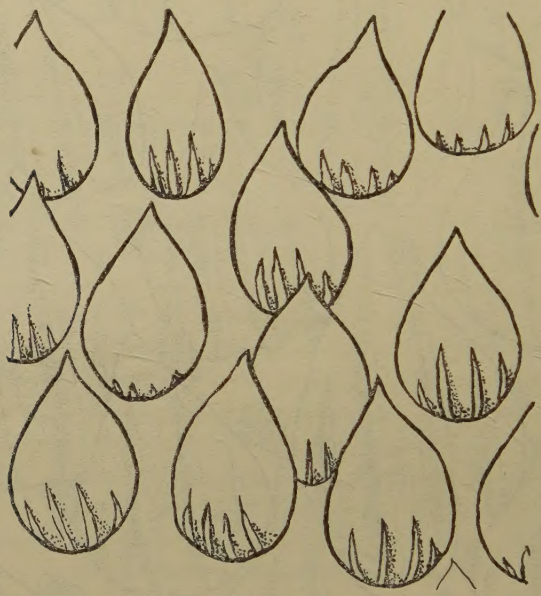

FIGURE 54.—Typical dermal denticles from the lateral surface of *Mustelus mustelus* (Linnaeus), showing short ridges.

them from all other species of the genus. *M. norrisi* is much more elongate and slender in form than *M. canis*, has teeth with higher crowns, a more strongly arched jaw, and narrower fins. It may be easily distinguished from *Mustelus mustelus* (Linnaeus) by comparisons of the dermal denticles, which, in that species, are not similar in structure on the flat surfaces of the body.

Mustelus mustelus probably is not normally, if ever, present in American waters but is most closely allied to *M. californicus* Gill. In these two species, specimens of all ages have strongly ridged denticles along the middorsal line, some of which have six instead of the four ridges characteristic of the genus as a whole. Away from the middorsal line, the ridges of the denticles become weak and do not reach more than half the distance to the posterior apex (see fig. 54), the

ridges becoming obscure and even absent on the belly. *M. mustelus* and *M. californicus* are not similar with respect to tooth form, but tooth form is an unstable character in the genus. In all the species that I have been able to examine in large series, some individuals, especially young ones, have been found with abnormal teeth of a more definitely tricuspid outline than would be usual to the species. Young specimens of *M. canis* frequently resemble young specimens of *M. mustelus* in this respect, but on the basis of the denticle characters they are easily separable.

MUSTELUS SCHMITTI, new species

Holotype.—An adult male, 742 mm in total length, U.S.N.M. no. 106640, collected on the coast of Uruguay by Dr. W. L. Schmitt in 1925.

Paratypes.—Two adult males, each 600 mm in total length, U.S.N.M. no. 87680, collected on the coast of Uruguay by Dr. W. L. Schmitt; an immature male, 450 mm in total length, U.S.N.M. no. 55582, collected by J. W. Titcomb, at Buenos Aires, Argentina; a young male, 260 mm in total length, U.S. N.M. no. 87782, taken on the coast of Brazil by Dr. W. L. Schmitt.

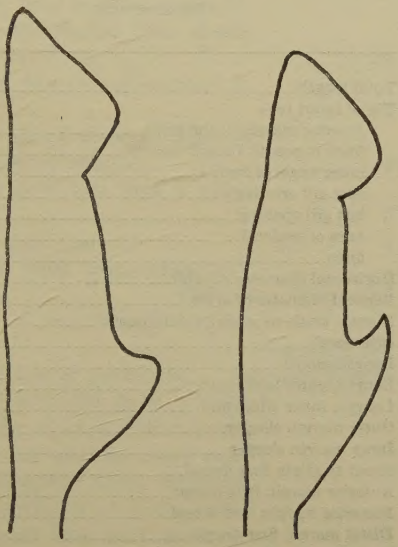

FIGURE 55.—Upper: Outline of the tail of an adult male *Mustelus griseus* Pietschmann, showing rounded lower caudal lobe. Lower: Outline of the tail of an adult male *Mustelus norrisi*, new species, showing pointed lower caudal lobe.

Description.—Similar in form to *Mustelus canis* but males reaching maturity at a small size (600 mm or less). Snout narrower. Fins broad; lower lobe of caudal not strongly developed, not acute; origin of the first dorsal in advance of the inner angle of the pectoral. Eyes smaller than in *M. canis* (horizontal diameter of orbit 2.5 percent of total length in average of five specimens as compared with 3.1 percent average for *M. canis* of comparable size); horizontal diameter of orbit greater than distance between the nostrils. Mouth broadly arched and rounded anteriorly in the adults; outer labial fold longer. Teeth paved, crowns not elevated in adults; accessory cusps present on the teeth of the young specimen, not on the adults examined. Dermal denticles similar in structure on the flat surfaces of the body, typical 4-ridged, with ridges reaching about two-thirds of the distance

to the posterior apex. Color uniform gray, without light or dark spots or bands.

Comparisons with other species.—*Mustelus schmitti* is most closely allied to *M. canis*. The most striking difference is in the smaller size of the eye, but this character is less reliable in old specimens in which the proportionate size of the head is reduced. The distance between the nostrils is less than the horizontal diameter of the orbit in all the specimens of *M. schmitti* examined, whereas in the large series of *M. canis* examined the internasal distance was always as great as and usually greater than the horizontal diameter of the orbit. The dermal denticles are less uniform in structure than in *M. canis*, the ridges of the denticles of the lateral surfaces extend only about two-thirds the distance to the posterior apex. A few denticles with five

TABLE 1.—*Measurements (in millimeters) of the types of* Mustelus

Measurement	*M. schmitti*	*M. norrisi*	
	U.S.N.M. no. 106640	U.S.N.M. no. 106639	U.S.N.M. no. 57369
Total length	742	723	825
Tip of snout to—			
anterior margin of the orbit	55	51	57
front of mouth (length snout)	45	42	44
outer angle of nostril	37	32	33
first gill opening	123	111	125
last gill opening	156	140	149
base of pectoral	152	134	136
anus	332	317	345
Horizontal diameter of orbit	17	20	23
Vertical diameter of orbit	8	10	9
Mouth, angle to angle (width mouth)	36	35	40
Internasal	16	19	20
Length mouth	24	24	27
Length, outer labial fold	16	8	10
Length, inner labial fold	9	7	9
Outer margin clasper	60	55	----
Inner margin clasper	104	81	----
Snout to origin first dorsal	225	215	262
Anterior margin first dorsal	88	87	105
Posterior margin first dorsal	29	23	24
Distal margin first dorsal	83	70	----
Base first dorsal	88	71	90
Interdorsal	161	190	175
Anterior margin second dorsal	78	63	85
Posterior margin second dorsal	24	23	17
Distal margin second dorsal	60	55	----
Base second dorsal	66	55	70
Second dorsal to beginning of caudal	80	80	90
Length upper caudal lobe	141	133	150
Length lower caudal lobe	59	58	72
Tip caudal to notch	64	45	55
Outer margin pectoral	102	101	125
Inner margin pectoral	60	45	55
Distal margin pectoral	86	80	----
Base pectoral	36	27	30
Anterior margin anal	40	46	51
Posterior margin anal	20	14	16
Base anal	40	41	45

or six ridges are present along the middorsal line. In this respect the denticle structure in *M. schmitti* is intermediate between that of *M. canis* and that of *M. mustelus* but closer to that of *M. canis*.

ARTIFICIAL KEY TO THE SPECIES OF MUSTELUS

The key given below will serve only to indicate some of the characters that may be used to separate the species described here from others of the genus. Many of these characters are of doubtful value and must remain so until large series can be studied. The nomenclature of the genus and the North Atlantic species follows the recent contributions by Dr. Carl L. Hubbs.[1] No attempt has been made to distinguish between the white-spotted species in the key, and *Mustelus mento* Cope and *Mustelus nigromaculatus* Evermann and Radcliffe are excluded from consideration here, as probably they are not referable to the genus.

1. Species with white spots of variable size and intensity, persistent along the sides where they tend to form an irregular line, and usually generally distributed over dorsal surfaces 13
   Species not white spotted; uniform in color or banded or spotted with darker 2
2 (1). Eye small, horizontal diameter of orbit 3 times or more in length of snout measured from front of mouth 3
   Eye larger, horizontal diameter of orbit less than 3 times in length of snout 5
3 (2). Color uniform, without transverse dark bars 4
   Color not uniform, dorsal surface with transverse dark bars ..... **fasciatus** (Garman)
4 (3). Origin of first dorsal in advance of inner angle of pectorals ..... **dorsalis** Gill
   Origin of first dorsal behind inner angle of pectorals ..... **osborni** Fowler
5 (2). Denticles of sides of body (typical denticles from a point about equal to horizontal diameter of orbit below origin of first dorsal) with short ridges not reaching more than one-third the distance toward posterior apex, denticles dissimilar in structure on flat surfaces of body, with ridges very strong near middorsal line and weak or absent on belly 12
   Denticles of sides of body with longer ridges (see fig. 53), the central two at least reaching two-thirds or more of the distance toward posterior apex, denticles nearly uniform in structure on flat surfaces of body 6
6 (5). Lower caudal lobe of adults not strongly developed, tip rounded 8
   Lower caudal lobe of adults strongly developed, tip acute 7
7 (6). Origin of first dorsal in advance of inner angle of pectoral ..... **lunulatus** Jordan and Gilbert
   Origin of first dorsal behind inner angle of pectoral ..... **norrisi**, new species

[1] Hubbs, C. L., Scientific names of the American "smooth dogfish," *Mustelus canis* (Mitchill), and of related European species. Occ. Pap. Mus. Zool. Univ. Michigan, no. 374, 19 pp., 1938.

8 (6). Species not spotted with black, color uniform 9
Black spots present on dorsal surface ..... **punctulatus** Risso
9 (8). Profile of functional surface of typical teeth of upper jaw of adults a regular curve, teeth without a projecting blunt crown or cusp 10
Profile of functional surface of typical teeth of upper jaw of adults an irregular curve, teeth with a projecting blunt crown or cusp 11
10 (9). Distance between nostrils usually greater than horizontal diameter of orbit; eyes of embryos at time of birth large (horizontal diameter of orbit less than 2 times in length of snout) ..... **canis** (Mitchill)
Distance between nostrils usually less than horizontal diameter of orbit; eyes of embryos at time of birth not proportionately large (horizontal diameter of the orbit more than 2 times in length of snout) ..... **schmitti**, new species
11 (10). Origin of first dorsal behind inner angle of pectoral; inner labial fold reaching farther forward than outer ..... **griseus** Pietschmann
Origin of first dorsal over or in advance of inner angle of pectoral; outer labial fold reaching farther forward than inner ..... **antarcticus** Günther
12 (5). Inner labial folds usually reaching farther forward than outer; teeth of adults usually without accessory blunt cusps or crowns ..... **californicus** Gill
Outer labial folds usually reaching farther forward than inner; teeth of adults frequently with accessory cusps on either or both sides of principal crown ..... **mustelus** (Linnaeus)
13 (1). *Mustelus asterias* Cloquet and *Mustelus manazo* Bleeker are white-spotted species. In all the specimens examined these spots have been present although not always distinct in those that have been in preservative for a long period. Pietschmann [2] regards these two species as identical. I have not examined a large enough series of *M. asterias* to form an opinion on this point, but certainly *M. manazo* has a wide range in the Pacific; specimens have been examined from San Diego, Calif., and Wanganui, New Zealand, as well as from the northwest Pacific. The type but not the paratypes of *Mustelus abbotti* Evermann and Radcliffe belongs here.

[2] Zur Unterscheidung der beiden europäischen Mustelus-Arten, Zool. Anz., vol. 33, p. 159–164, 1908.

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